

1 Introduction

Background

Energy savings performance contracts (ESPCs) are a relatively recent contracting development. ESPCs are used to obtain a variety of energy services ranging from commodity provision on a regional basis; to assumption of operation of utility plants and distribution systems; to identification, implementation, and maintenance of energy and water efficiency capital improvements. ESPCs provide a means of obtaining needed resources such as manpower and technical expertise by paying for those resources through savings from reductions in facility energy use. Additional benefits may include reductions in greenhouse gas emissions and oil consumption, increases in energy efficiency, expansion of the use of renewable energy sources, and identification and implementation of energy and water saving measures. Depending on the nature of the agreement, ESPCs allow the private sector and Federal agencies to reduce energy consumption and improve efficiency in facilities, with potentially no capital investment from the end-user.

However, it seems that ESPC contractors have exhausted the “low hanging fruit” opportunities for energy savings. Future projects will likely be increasingly complex and require technical and methodological support that will allow for more detailed energy systems assessment, better understanding of the available technologies and their level of their maturity, accurate replacement technology benchmarking, and economic guidance.

The U.S. Department of Defense (DOD), U.S. Department of Energy (DOE), and the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) share a common interest in developing a “tool-kit” to support ESPCs, to address:

- energy assessment and analysis methodologies, analytical, and experimental and field evaluation tools that allow for energy conservation with rational capital investments for different types of buildings
- evaluation and selection of mature energy saving technologies, and development of a road map for retrofitting aging energy systems
- life-cycle cost analysis (LCCA) and benchmarking principles for ESPCs, along with measurement and verification methodologies
- the pros and cons of different financial and organizational strategies for ESPCs.

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A wealth of information related to current practices in implementing ESPCs is available from around the world. This workshop was organized to assemble ESPC end-users, contractors, researchers, and manufacturers to share the information and needs related to ESPCs and to explore future activities that DOD and DOE are considering in their effort to undertake a new International Energy Agency Demand Side Management (DSM) project.

Objective

The objectives of this Workshop were to bring together ESPC end-users, contractors, researchers, and manufacturers to share the information and needs related to ESPCs and to explore future activities that DOD and DOE are considering in their effort to undertake a new International Energy Agency DSM project.

Approach

Construction Engineering Research Laboratory (CERL) planned an international industry workshop to advance discussion on the topic of "Building Energy Performance Improvement Through Advance Technologies, Smart Organization, and Financing," which was held 7-8 October 2003. The workshop was publicized through mailings and the World Wide Web (WWW). Participants were invited to make formal presentations and to submit the content of their presentations for publication in this proceedings. Table 1 lists the workshop program and the Microsoft® PowerPoint® presentations that were submitted for publication.

Scope

Chapters 2 through the Appendixes of this document are included on an accompanying CD-ROM containing the Microsoft® PowerPoint® graphical slide presentations given at the *Industry Workshop*, 7-8 October 2003, converted to Adobe® Portable Document Format (PDF) format. The report includes no text summary of the verbal presentations that accompanied the electronic slides.

Mode of Technology Transfer

This proceedings will be made accessible through the World Wide Web (WWW) at URL:

http://www.cecer.army.mil/techreports/Zhivov_IndustryWorkshop_SR/Zhivov_IndustryWorkshopProceedings_SR.pdf

Table 1. Workshop Program.

Chapter (CD-ROM)	Date/Time	Presenter	Topic
Tuesday, 07 October 03			
	7:30-8:00		Registration
Ch. 1	8:00-8:15	Dr. Alexander Zhivov, ERDC-CERL.	Introduction to the Workshop
	8:15-8:30		Participants Self-Introductions
	8:30-10:15	Session 1. ESPC Issues	
	8:30-8:45	Mr. David Shockley, US Army Corps of Engineers, Huntsville	
	8:45-9:00	Mr. Gordon Drawer, US DOE, FEMP — Chicago Reg. Office	
Ch 3	9:00-9:15	Mr. Buster Barksdale, SAIC	ESPC Issues—DOD/DOE ESPC Initiative and Six Task Force Issues
Ch 3	9:15–9:30	Mr. Venkat Kumar, Johnson Controls	Building Energy Performance Drives Increased Energy & Operational Efficiency, Reduced Emissions & Improved Infrastructure—Putting a Value on the Improvement
	9:30-10:15		Q&A, Forum Discussions
	10:15-10:45		Coffee Break
	10:45-12:30	Session 2. Current Guidelines, Codes and Standards, Addressing Energy Efficiency and Conservation	
Ch 4	10:45-11:00	Mr. Ronald Jarnagin, Pacific Northwest National Laboratory (PNNL)	ASHRAE and DOE Standards and Guidelines Addressing Energy Efficiency
Ch 4	11:00-11:15	Dr. Christoph Weber, University of Stuttgart (Germany)	Energy Performance Regulations for Buildings in Europe
Ch 4	11:15-11:30	Mr. Donald Fournier, University of Illinois, Urbana	Army Energy Policy and Plans
Ch 4	11:30-11:45	Mr. Kelly Jon Andereck	A Design Energy Efficiency Environmental Consulting. Using "Green" To Make "Green"
	11:45-12:30		Q&A, Forum Discussions
	12:30-13:30		Lunch on your own

Chapter (CD-ROM)	Date/Time	Presenter	Topic
	13:30-15:45	Session 3. Building Energy Assessment Methodologies and Practices	
Ch 5	13:30-13:45	Dr. Curt Bjork, Energy @ Optimum (Sweden)	Assessment of Industrial Energy Systems—A Well-Defined Methodology is the Key to Success and to Investment Decisions
Ch 5	13:45-14:00	Dr. Charles Culp, Texas A&M University, ESL	Continuous Commissioning—An Effective Method for Energy Reductions
Ch 5	14:00-14:15	Mr. Michael Chimack, University of Illinois in Chicago, ERC	Assessing Energy Use and Conservation in Commercial and Institutional Buildings
Ch 5	14:15-14:30	Dr. Andrey Strongin, Central Research Institute for Industrial Buildings (Russia)	Energy Assessment and Audit Methodology for Refurbishing Buildings
Ch 5	14:30-14:45	Dr. Mike Lin. ERDC-CERL	Process Energy and Pollution Reduction at DOD Facilities
Ch 5	14:45-15:00	Dr. Christoph Weber, University of Stuttgart (Germany)	Methodology for Cost Effective Assessment of Heat Recovery Potentials
	15:00-15:45		Q&A, Forum Discussions
	15:45-16:15		Coffee Break
	16:15-17:30	Session 4. LCCA, Measuring and Verification	
Ch 6	16:15-16:30	Dr. Charles Culp, Texas A&M University, ESL	Cost Effective M&V for the Department of Defense
Ch 6	16:30-16:45	Mr. David Underwood, ERDC CERL	A Tool for M+V Cost Estimating
Ch 6	16:45-17:00	Dr. Sieglinde Fuller, NIST. NIST/FEMP BLCC5	Building Life-Cycle Cost Program
	17:00-17:30		Q&A, Forum Discussions
Wed, 8 October 03			
	8:00-8:15		Opening remarks
	8:15-11:45	Session 5. Energy Analysis Tools	
Ch 7	8:15-8:30	Mr. Donald Fournier, University of Illinois, Urbana	Energy assessment and analysis using REEP
	8:30-8:45	Mr. James Dirks, PNNL	Energy assessment and analysis using FEDS
Ch 7	8:45-9:00	Dr. Michael Witte, GardAnalytics	Whole building energy analysis using EnergyPlus
	9:00-9:15	Dr. Curt Bjork, Energy @ Optimum (Sweden)	Assessment of Industrial Energy Systems—Tools for Optimal and Stable Solutions
Ch 7	9:15-9:30	Mr. Jeff Johnson, New Building Institute and Ms. Abby Vogen, Energy Center of Wisconsin	A Pattern Approach to High Performance Buildings— E-Benchmark

Chapter (CD-ROM)	Date/Time	Presenter	Topic
	9:45-10:00	Mr. Simon Wössner, Fraunhofer-Institut für Bauphysik (Germany)	IEA Energy Conservation in Buildings & Community Systems Program (ECBCS). Retrofitting in Educational Buildings—Energy Concept Adviser for Technical Retrofit Measures
	10:00-10:30		Coffee Break
Ch 7	10:30-10:45	Mr. David A. Eijadi, The Weidt Group	Energy Design Assistance for High Performance Buildings
	10:45-11:00	Mr. Douglas Haas, SEMCO Incorporated	Energy Savings Associated with the Utilization of Total Energy Recovery for Preconditioning Outside Air
	11:00-11:45		Q&A, forum discussions
	11:45-12:45		Lunch on your own
	12:45-16:30	Session 6. New Technologies for New and Existing Buildings Allowing for Energy Conservation	
Ch 8	12:45-13:00	Mr. Richard Remke, Carrier Corp.	Demand Controlled Ventilation—Save energy with a better operating Building
Ch 8	13:00-13:15	Mr. Leon Shapiro, ADA Systems	Conserve Energy and Improve Indoor Air Quality through Use of Hybrid HVAC Systems
Ch 8	13:15-13:30	Mr. Mike Lemmon, LSB Industries	Geothermal opportunities for ESPCs
Ch 8	13:30-13:45	Mr. Douglas Haas, SEMCO Incorporated	Case Histories Utilizing Total Energy Recovery for Preconditioning Outside Air
Ch 8	13:45-14:00	Mr. David Scheidler, Plymovent	Energy Saving with Demand Controlled Ventilation
Ch 8	14:00-14:15	Mr. William Ryan, University of Illinois in Chicago, ERC	A Robust Tool for Screening. Tool for Combined Heat and Power Technologies in to-days Energy Marketplace
Ch 8	14:15-14:30	Dr. Eugene Shilkrot, Central Research Institute for Industrial Buildings, Russia	Assessment of HVAC systems reliability
	14:30-15:00		Coffee break
Ch 8	15:00-15:15	Mr. Roch Ducey, ERDC-CERL	Energy Security
	15:15-15:30	Mr. Brian Olsen, US DOE, OIT—Chicago Reg. Office	TBD
	15:30-15:45		DOE- Building Technologies—TBD
	15:45-16:30		Q&A, forum discussions
	16:30- 17:30	Session 7. Energy Saving Performance Contracts: Forms and Financing Options	
Ch 9	16:30-16:15	Mr. Jorma Pietilainen, VTT, Finland	Overview of activities related to energy efficiency improvement in Finland

Chapter (CD-ROM)	Date/Time	Presenter	Topic
Ch 9	16:15-16:30	Mr. Buster Barksdale, SAIC	Energy Savings Performance Contracts—vehicles and financing options
	16:30-16:45		ORNL—TBD
	16:45-17:30		Q&A, forum discussions
	17:30-17:45		Final remarks

2 Workshop Introduction

Presenter: Alexander Zhivov



Chicago, September 7-8, 2003

***Building Energy Performance Improvement through
Advance Technologies, Smart Organization and Financing***

Industry Workshop

Organized by US Army Corps of Engineers ERDC-CERL

Co-sponsored by USACE and ASHRAE

Industry Sponsors

 ***Johnson Controls, Inc., Exelon, Inc., Plymovent Corp. University of Illinois in Chicago***

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Industry Workshop Objectives

- *Share the information and needs related to ESPC*
- *Define and scope tasks for the new project*
“Building energy performance improvement through advance technologies, smart organization and financing – ESPC Tool-kit,”
proposed to undertake under the International Energy Agency Demand Side Management Program



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Issues

- ESPCs have demonstrated significant opportunities for Federal building energy and water systems efficiency and performance improvements. However, ESPC utilization has slowed down, and its full potential remains untapped.
- ESPC contractors have exhausted the “low hanging fruit” opportunities for energy savings by already completing the secure, tried and true, high return on investment projects. Contractors and end-users generally are unwilling to risk applying new Demand Side related technologies. Whole building energy performance optimization is rarely addressed by ESPCs...same for whole building Cx’g
- Adequate returns on projects are suspect by all involved parties. Performance measurements and verification are among critical issues



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Proposal for New IEA Demand Side Management Project

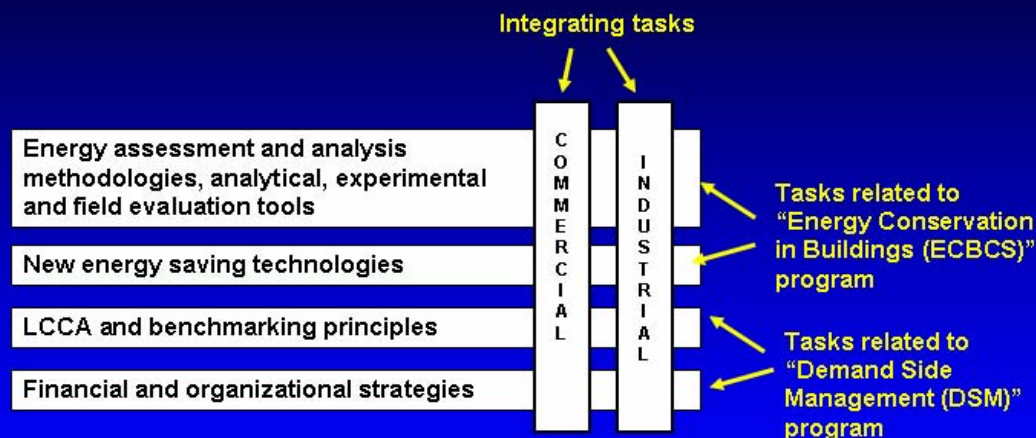
- Project aim. Develop a practical tool-kit providing technical and methodological support to ESCOs and end users, allowing for
 - more detailed building, load and systems assessment for energy,
 - better understanding of the available technologies and the level of their maturity,
 - accurate replacement technology benchmarking, and economic guidance
- Scope. Public and industrial buildings,
- Participants. US Army Corps of Engineers, DOE FEMP, OBT and Labs, ASHRAE, Academia, IEA and private sector.
- Target audience. Federal buildings energy managers and ESCOs.



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Project Structure



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Objectives of the Proposed Project

- Provide an opportunity for improved building energy performance, indoor air quality and thermal environment by incorporating different building, process and energy systems related measures into the Energy Saving Performance Contracts;
- Arm our energy managers with proven technical and methodological tools to craft optimal business contracts with ESCOs and influence ESCOs to take more technical risks:
 - Deeper energy systems assessment; complex groups of technologies
 - Better understanding of the available technologies and the level of their maturity, and
 - Accurate replacement technology benchmarking
- Analyze current practices and methodologies used for ESPCs Life Cycle Cost Analysis and develop consensus methodology to be used by ESCOs
- Based on analysis of current practices, develop a road-map for energy managers specifying different types of energy saving performance contracts, their pros and cons.



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1. Energy assessment and analysis tools

- Increase in energy efficiency will need increased number of high quality energy audits/surveys;
- Cost effective energy saving measures can be found only when trained energy auditor is involved and energy audit/survey is conducted using consistent approach;
- To fulfill the needs of the federal sector a consensus energy analysis methodology will be compelled from the state-of-the-art international experiences and result in the "*Energy Assessment Guide/Adviser for Energy Managers and ESCOs.*"



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1a. Targeted Audience for Energy Assessment Methodology

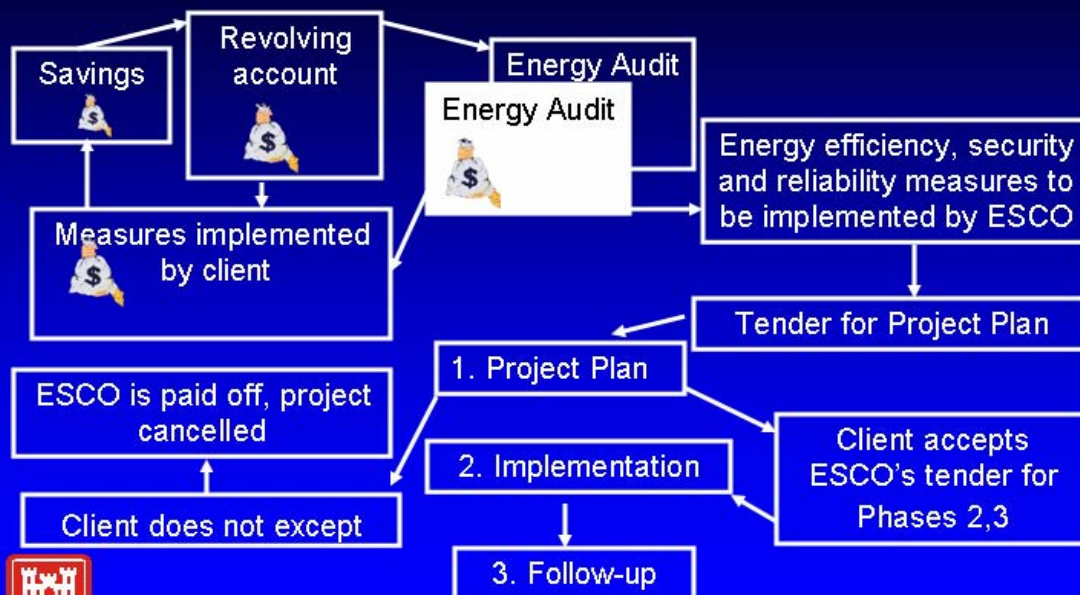
- Energy managers
- ESCO energy auditors
- Independent energy auditors
- Energy auditor training programs



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1b. Energy Audit Concept with an Independent Agency (adopted from the Finnish model)



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2. Energy Saving Technologies and Measures for Building Retrofits

- Identify promising technologies/measures
- Identify tools/computer programs for technology/measures screening
- Identify representative screening conditions (building type, standard climatic conditions, energy costs, etc)
- Conduct screening
- Present results in the user-friendly format of the *Guide to "Energy Saving Technologies and Measures for Building Retrofits"* with pros and cons for each measure



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2a. Technology Screening Tools

- Regional/installation wide analysis for a broad spectrum of HVAC technologies, utility distribution systems, envelop modifications, lighting, domestic hot water and renewable energy technologies - Renewable and Energy Efficiency Planning (CERL);
- Energy analysis of single buildings or large installations with many buildings with determination of potential retrofits and their cost effectiveness, calculation of electrical demand and energy consumption - Facility Energy Decision System
- (PNNL), ESpr (ESRU);
- Detailed energy analysis of a specific building equipped with different systems and their components - DOE-2 (DOE), BLAST (CERL,UoI), TSB13 (Danish Building Res.Inst.)
- Detailed energy analysis for each separate part of the system and building zone - TRNSYS (UoW)



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2b. Energy Saving Technologies/Measures and their Applications Database

- **Building envelope optimization** (e.g., building envelope insulation, caulking and weather-stripping, exterior window shading, vestibules, air curtains, etc);
- **Internal load reduction** (e.g., lighting, motion sensors, use of EnergyStar appliances, process encapsulating, optimization and control, compressed air systems, etc.)
- **HVAC system related** (e.g., separation of V and HAC systems, hybrid ventilation, VAV systems, efficient air distribution strategies, AHU process optimization, BMS, VFD, high efficiency motors, chillers and furnaces, waste heat recovery, hybrid ground and air source heat pumps, etc.)



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3. Life Cycle Cost Analysis and Benchmarking

- **Analyze currently used LCCA models**
- **Compare these models and select one which is more applicable for ESPCs**
- **Develop LCCA guide targeted at energy managers, ESPC contractors**
- **Develop benchmarking principles**



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4. Financial and Organizational Strategies for ESPCs

- *Based on IEA report produced by NAESCO, ORNL recommendations, analysis performed by SAIG findings, results from IEA DSM Program, Task X, develop "Organizational and Financial Options. Guide for Energy Managers"*



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Questions for speakers and the Workshop participants

- Any changes to the draft proposal for the project under the IEA DSM Program ?
- Any interest from your organization to participate in the project (with or without IEA umbrella)?
- Does your organization has any ongoing projects which can match the proposed effort?
- Any funds or in-kind contribution to this project from your organization?
- Interest to participate in demonstration or show-case studies, which can be conducted after finalizing developmental stage of the project
- What are technology gaps related to ESPC business now? ...5 years from now?
- How to motivate ESCOs to address energy security, reliability as an integral part of their proposals?



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